

ULL 754-5-1

MOBILE COMPUTING AND COMMUNICATIONS REVIEW

A PUBLICATION OF ACM SIGMOBILE

January 2001

Volume 5

Number 1

Special Issue Dedicated to Claude E. Shannon

Eulogy for Claude Elwood Shannon

Gerhard Kramer, James E. Mazo, and Serap A. Savari 1

Claude Shannon, Father of Information Theory, Dies at 84..... 2

A Mathematical Theory of Communication

C. E. Shannon 3

The Significance of Shannon's Work

Aaron D. Wyner 56

SIGMOBILE Award Nominations 57

CALL FOR PAPERS AND PARTICIPATION

MobiCom 2001 58

MobiHoc 2001 59

Workshop on Principles Of Mobile Computing..... 60

SIGMOBILE MC²R Back Cover

MC²R

EDITOR-IN-CHIEF

Victor Bahl, bahl@microsoft.com
Microsoft Research

ASSOCIATE EDITOR

Jason Redi, redi@bbn.com
BBN Technologies

ADVISORY BOARD

Donald Cox, Stanford University, USA
Randy Katz, University of California, Berkeley, USA
Mischa Schwartz, Columbia University, USA

AREA EDITORS

Hamid Aghvami, King's College London, London, UK
Mary Baker, Stanford University, USA
Hari Balakrishnan, MIT, USA
David Everitt, University of Melbourne, Australia
Yuguang Fang, New Jersey Institute of Tech., USA
Bernd Girod, U. of Erlangen-Nuremberg, Germany
Andy Hopper, University of Cambridge / ORL, UK
Ravi Jain, Bellcore, USA
David B. Johnson, CMU, USA
Yi-Bing Lin, National Chiao Tung University, Taiwan
Mahmoud Naghshineh, IBM, USA
Dipankar Raychaudhary, Rutgers University, NJ, USA
Dan Siewiorek, Carnegie Mellon University, USA
Mani B. Srivastava, UCLA, USA

FEATURE EDITORS

M. Scott Corson, University of Maryland, USA
James C. Lin, University of Illinois at Chicago, USA
Joseph P. Macker, Naval Research Laboratory, USA
Brian Noble, University of Michigan, USA
Charles Perkins, Nokia Corporation, USA

ACM STAFF

Lisette Burgos, *Program Director*
Erin Dolan, *Administrative Assistant*
Lynne Lancaster, *Advertising Director*

SIGMOBILE

EXECUTIVE COMMITTEE

Imrich Chlamtac, University of Texas, Dallas, *Chair*
Victor Bahl, Microsoft Research, *Vice Chair & MC²R*
David Johnson, CMU, *Treasurer*
Chris Rose, Rutgers University, *Secretary*
On-Ching Yue, Lucent Tech., *Membership Recruitment*

CONFERENCE/WORKSHOP COORDINATOR

Ravi Jain, Bellcore, USA

PUBLICITY DIRECTOR

Sajal Das, University of North Texas, USA

Mission Statement of ACM SIGMOBILE

The purpose of ACM SIGMOBILE is to promote research and development by bringing together researchers and practitioners and fostering interest in the mobility of systems, users, data, and computing. SIGMOBILE will address the above spectrum of topics, sharing one common theme - mobility. The group's technical scope reflects the emerging symbiosis of portable computers and wireless networks, addressing the convergence of mobility, computing, and information organization, its access, services, management and applications.

With emphasis on the various areas of nomadic computing, data management, related technologies, and mobile user services, alongside more "classical" topics in wireless and mobile networking, the list of following areas can be considered to be representative of SIGMOBILE's activity:

- Nomadic computing, applications and services supporting the mobile user
- Design and analysis of algorithms for online and mobile environments
- Protocols to cope with mobility, limited bandwidth, and intermittent connectivity
- Data management issues in mobile environments
- Mobile and wireless networks and their architectures
- Mobility management, mobile agents and proxy architectures
- Mobile, location-dependent and sensitive applications
- Wearable computers and body area networks
- Systems and technologies for wireless and mobile environments
- Performance characterization of mobile/wireless and nomadic systems
- Design, management and operation of emerging wireless environments
- Mobile network planning and standardization
- Integration of wireline and wireless systems
- Security, scalability and reliability in wireless communication environments
- Service algorithms, emerging topics, multimedia, ATM, etc.

SUBMISSION

ACM MC²R welcomes tutorial, survey, and research articles on topics outlined above. Submissions will normally be 4000 words, accompanied by several figures and/or tables, with a limited number of carefully selected references. Submission format and guidelines can be obtained from MC²R's web site (<http://www.acm.org/sigmobile/MC2R>)

NOTICE TO CONTRIBUTING AUTHORS TO SIG NEWSLETTERS

By submitting your article for distribution in this Special Interest Group publication, you hereby grant to ACM the following non-exclusive, perpetual, worldwide rights: to publish in print on condition of acceptance by the editor; to digitize and post your article in the electronic version of this publication; to include the article in the ACM Digital Library; to allow users to copy and distribute the article for noncommercial, educational or research purposes. However, as a contributing author, you retain copyright to your article and ACM will make every effort to refer requests for commercial use directly to you.

NOTICE TO PAST AUTHORS OF ACM-PUBLISHED ARTICLES

ACM intends to create a complete electronic archive of all articles and/or other material previously published by ACM. If you have written a work that has been previously published by ACM in any journal or conference proceedings prior to 1978, or any SIG Newsletter at any time, and you do NOT want this work to appear in the ACM Digital Library, please inform permissions@acm.org, stating the title of the work, the author(s), and where and when published.

EDITORIAL CORRESPONDENCE

Address to: Victor Bahl, Microsoft Research, One Microsoft Way, Redmond, WA 98052-6399, USA, bahl@microsoft.com. For specific departments please see corresponding columns.

ACM MC²R

ACM MC²R is published four times annually by ACM SIGMOBILE for its members. The Newsletter has a controlled distribution with the compliments of ACM SIGMOBILE. MC²R assumes no responsibility for the return of submitted manuscripts, photographs, artwork, or other material. Nothing in this publication shall constitute an endorsement by ACM, or SIGMOBILE or MC²R (collectively, the "Publisher") of any information contained in this publication, and the Publisher disclaims any liability with respect thereto or the use or reliance on any such information. The information contained in the publication is in no way to be construed as a recommendation by the Publisher of any kind or nature whatsoever, nor as a recommendation of any industry standard, nor as an endorsement of any product or service, nor as an opinion or certification regarding the accuracy of any such information.

Eulogy for Claude Elwood Shannon

Gerhard Kramer

James E. Mazo

Serap A. Savari

Bell Laboratories, Lucent Technologies, Murray Hill, NJ, USA

Claude Shannon died on February 24, 2001, at age 84. He was a brilliant mathematician whose outstanding contributions were to establish theoretical limits for problems of great engineering relevance. Information Theory was born in his 1948 paper, “A Mathematical Theory of Communication”. Shannon here teaches us the importance of understanding the probabilistic behavior of long sequences of symbols. It is in the asymptotic realm of sequences where the interesting mathematics is to be found. Shannon showed that it suffices to consider sequences of binary digits, or bits, and he proceeded to develop his notion of entropy that gives the fundamental limits of efficient communication. A particularly striking concept was his channel capacity. All communication engineers at that time knew that arbitrarily reliable transmission could be achieved simply by repeating symbols many times, although, of course, the transmission rate would drop to zero. It was a complete shock when Shannon found that such reliability could be achieved at a positive rate - channel capacity. Nothing like this had been dreamed of before. Moreover, the goal of approaching the theoretical limits of efficient and reliable communication turned out to be so rich that it has supported an entire field of investigation since that time. New communication applications are best understood via their fundamental achievable limits, and we use Shannon’s ideas to tackle such problems. Current research in fiber-optic and wireless transmission uses Information Theory on a daily basis. Quantum Information Theory is one of the hottest areas on the border of engineering, physics and computation. “Information is physical” is a quote we recall. Perhaps “physics is information” lies in our future understanding of the world. As his work becomes more and more prevalent in today’s Information Age, it is becoming increasingly clear that Claude Shannon was one of the greatest minds of the twentieth century.

Claude Shannon, Father of Information Theory, Dies at 84*

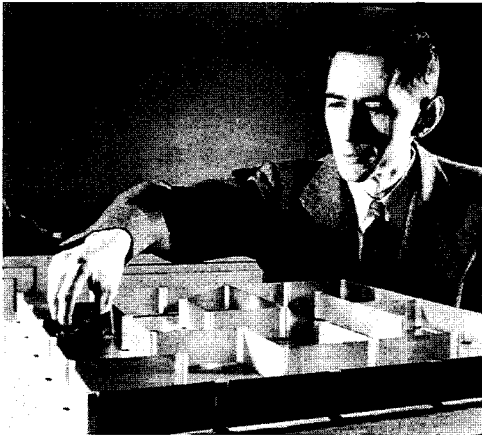
Murray Hill, N.J. (Feb. 26, 2001) – Claude Elwood Shannon, the mathematician who laid the foundation of modern information theory while working at Bell Labs in the 1940s, died on Saturday. He was 84.

Shannon's theories are as relevant today as they were when he first formulated them. "It was truly visionary thinking," said Arun Netravali, president of Lucent Technologies' Bell Labs. "As if assuming that inexpensive, high-speed processing would come to pass, Shannon figured out the upper limits on communication rates. First in telephone channels, then in optical communications, and now in wireless, Shannon has had the utmost value in defining the engineering limits we face."

In 1948 Shannon published his landmark *A Mathematical Theory of Communication*. He begins this pioneering paper on information theory by observing that "the fundamental problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point." He then proceeds to so thoroughly establish the foundations of information theory that his framework and terminology remain standard.

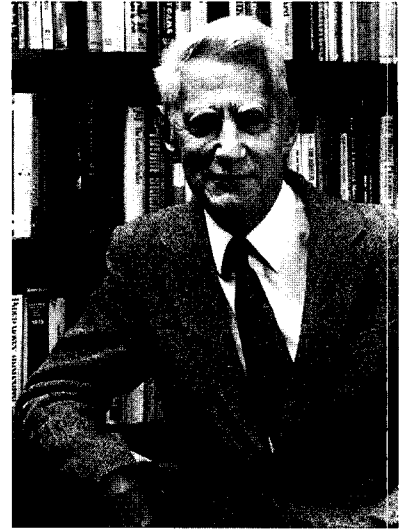
Shannon's theory was an immediate success with communications engineers and stimulated the technology which led to today's Information Age.

Shannon published many more provocative and influential articles in a variety of disciplines. His master's thesis, *A Symbolic Analysis of Relay and Switching Circuits*, used Boolean algebra to establish the theoretical underpinnings of digital circuits. This work has broad significance because digital circuits are fundamental to the operation of modern computers and telecommunications systems.



Claude Shannon's clever electromechanical mouse, which he called Theseus, was one of the earliest attempts to "teach" a machine to "learn" and one of the first experiments in artificial intelligence.

In his words "I just wondered how things were put together."



Claude Shannon

Another example is Shannon's 1949 paper entitled *Communication Theory of Secrecy Systems*. This work is now generally credited with transforming cryptography from an art to a science.

Shannon was born in Petoskey, Michigan, on April 30, 1916. He graduated from the University of Michigan in 1936 with bachelor's degrees in mathematics and electrical engineering. In 1940 he earned both a master's degree in electrical engineering and a Ph.D. in mathematics from the Massachusetts Institute of Technology (MIT).

Shannon joined the mathematics department at Bell Labs in 1941 and remained affiliated with the Labs until 1972. He became a visiting professor at MIT in 1956, a permanent member of the faculty in 1958, and a professor emeritus in 1978.

Shannon was renowned for his eclectic interests and capabilities. A favorite story describes him juggling while riding a unicycle down the halls of Bell Labs.

He designed and built chess-playing, maze-solving, juggling and mind-reading machines. These activities bear out Shannon's claim that he was more motivated by curiosity than usefulness.

*Reproduced with the permission of Bell Labs, Lucent Technologies.